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A look into the United States' Underfunded Pension System

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Abstract:

The public pension crisis has come under increasing scrutiny over the past decade as shifting demographic trends, harsh economic conditions and the very nature of pension funds have changed, and not for the better. Pension funds create valuable saving and investment tools for an individual's retirement. They make what seems like the impossible daunting task of saving sufficient funds for retirement completely feasible. All indications lead to these trends continuing, therefore pension plans need to adapt and reform. This paper is to address the pension crisis in the U.S. and intends to provide some recommendations for policy makers.

This paper used the U.S. Census Bureau pension data for the fiscal years 2005-2014 to select a sample of 15 states. The time series data will be analyzed using the MDA (Multiple Discriminant Analysis) methodology to assess if a pension plan is bound to fail. MDA is used in the banking industry as a method to predict financial distress or default of bank loans. Once the regression line is determined, it can be utilized to estimate the probability of default. This methodology will be used to determine financial health of public pensions selected in the sample.

The Multiple Discriminant Analysis model can be utilized to run a stress test on the public pension plans of those states selected in the sample. The Multiple Discriminant Analysis will enable public pensions and policy makers to somewhat predict the viability of their pensions. The contribution of this paper will be providing pre-warning signals and some policy recommendations for local governments to sustain their pension systems.

Key words: Pension Fund, Multiple Discriminant Analysis

1. Introduction:

Saving for retirement poses some of the biggest financial hurdles for an individual's savings goals. Retirement saving requires a person to ditch financial myopia and look into the future in order to save funds to finance their post work life. Saving for the future can be difficult with current obligations and is susceptible to significant financial risks. Luckily, strategies to improve stability and employer contributions to increase value have been developed.

The goal for retired individuals is to enjoy the same lifestyle, without working, that they have enjoyed throughout their years. For a young person this seems almost unfathomable, but with adequate goals and execution this can be attained. However, it will not be without struggle; inflation, volatility and increasing life expectancy serve as significant complications.

The likelihood is that goods, services, and the overall cost of living will be substantially higher once an individual reaches retirement age. This will create a decrease in purchasing power for the retiree in the future. Optimal retirement saving should begin in an individual's early twenties. If the retirement age is sixty-five, there are forty or more working years before retirement. Inflation over a forty-year time period can be substantial, for example, $1 in 1975 would have a $4.41 value in 2015.

Investing the money saved is a crucial step in generating adequate wealth to fund retirement; simply put, let the money you save generate wealth. However, long-term investment poses significant risks. Economic and market volatility can threaten the returns of investment and wipe out retirement funds if not protected properly.

Life expectancy also complicates retirement. Life span is finite, however not specifically defined. The Organization for Economic Cooperation and Development estimated the United States average life expectancy is 78.7 years in 2011. This is below the average of 80.1 years among the 36 member states. Additionally, women have a slightly longer average life span of 81 years compared to men with an average life span of 76 years. Regardless, this indicates that there will be ten or more years of retirement for the average person. This can only stand to increase as improvements in medicine and healthcare are expected to increase longevity.

Given these challenges, saving for retirement individually can be nearly impossible. However, retirement funds such as Public Pensions, Individual Retirement Arrangements (IRA) and 401(k)s have been developed to assist saving and create large contribution plans that provide payout through retirement. Although these plans have optimistic goals and have previously supported millions of retirees, they have run into problems most recently. These struggles can be attributed to changing mismanaged funds, workforce demographics, increased life expectancy and a decreasing support ratio.

According to Investopedia.com, "a pension fund is a fund established by an employer to facilitate and organize the investment of employees' retirement funds contributed by the employer and employees. The pension fund is a common asset pool meant to generate stable growth over the long term, and provide pensions for employees when they reach the end of their working years and commence retirement." Financial intermediaries are tasked with making investments with the capital provided by contributors to the fund. The investments undertaken are generally long-term, low-risk growth investments. The fund is not required to pay capital gains tax and earnings are tax deferred. The pension plan will have no tax obligation until money is withdrawn from the fund in the form of retirement income payments.

There are two types of plans, defined benefit plans and defined contribution plans. A defined benefit plan is a company pension plan where employee retirement payments are calculated using a mathematical formula based on length of service with the company and their respective salary throughout their career. A defined contribution plan is an agreement where the employee, employer or both make regular contributions to the retirement fund. This allows the employee to define how much to contribute and in some cases how to invest it. Retirement payments are calculated on the basis of amount contributed and performance of investment. The latter plan is not technically considered a pension, and therefore defined benefit plans will be focused on for the purpose of this paper.

A pension fund is ideally meant to hold onto money so that current employees can have peace of mind and a sense of stability in their uncertain futures. Unlike a defined contribution plan such as a 401(k) where employees set aside money and invest it with the knowledge that that is their retirement plan with no guarantees on its future, employees under pension plans are guaranteed a certain amount of money after retirement. The funds for the pension often come from both the employees and the employer. Pension fund employers today are most often the government at the local, state or federal level; while some traditional businesses do use pension funds, this paper will focus on pension funds for government employees due to the potential impact on taxpayers. While pensions are a guarantee for the employees, the reality is pension funds across the country are underfunded, and for a variety of reasons. If the present value of expected retirement benefits is equal to the fund's assets on hand, then the plan is called fully funded. If the present value of benefits exceeds assets, the plan is underfunded, and an underfunded pension liability exists.

2. Literature Review:

*"Hidden Debt, Hidden Deficits: How Pension Promises Are Consuming State and Local Budgets"***,** in this essay published April 11th, 2016, author Joshua D. Rauh explores the pension crisis and the benefits that are promised to most state and local employees. Rauh goes into detail to describe how, despite new updates from the Governmental Accounting Standards Board (GASB), most pension funds use too high of estimated returns to calculate their pension costs and liabilities. Rauh then uses new GASB disclosures known as GASB 67 to explore two parts of the pension fund crisis. Rauh first calculates total underfunded liabilities through 2014 estimating for each plan accrued liabilities under risk-free discounting. Rauh then uses the GASB 67 to look at the changes in value of pension liabilities to find the deficits that are being run throughout the year.

"Deferred Promises: America's Pension Crisis", in this eight part series from NPR in 2010; NPR investigates the failing pension funds across the United States. The series highlights America's two most troubled states when it comes to their pension funds; the shortcomings of Illinois's ballooning pension deficit, and the comparison of Kansas and its struggling pension fund to the state of Nebraska who while similar in mostly every aspect is doing much better when it comes to Nebraskan state employees' retirement benefit plans. From Rhode Island to California, NPR illuminates the aspects of the growing pension fund crisis and while dated many of the stories still seem to be representative of the current state of affairs.

When asking why pension funds are underfunded the first reason that most would point out is the state of the economy. The pension funds are ideally invested in safe assets that look to promise steady returns; therefore, governments with access to the funds will keep less money in the fund than actually needed because they expect to have returns on those assets that will meet the requirements in the coming years. In his essay, Joshua D. Rauh details the practice of having less than needed for pension funds: *"A 7.6 percent expected return implies that state and city governments are expecting the value of the money they invest today to double every 9.5 years. That means that a typical government would view a promise to make a worker a $100,000 payment in 2026 as "fully funded" even if it had set aside less than $50,000 in assets in 2016; and a payment in 2036 would be viewed as "fully funded" with less than $25,000 in assets in 2016."*

In recent years, the Federal Reserve has held interest rates between .25 -. 50%; these low interest rates provide little return on investment especially for pension funds that have relatively safe assets. This means that the pension funds need to set aside more money than they would normally if they were receiving those higher returns; however, this isn't happening. According to one report featured in NPR's ***"****Deferred Promises: America's Pension Crisis",* across the nation, state pension funds decreased 25% in value in 2008. The crash in the housing market that led to the Great Recession also played a factor in the reduction of funds, in a 401(k) this would impact individual savings, but in pension plans, specifically at the state and

federal level, the government is on the hook and governments will be subject to find a solution which ultimately means that taxpayers are on the hook.

There is more to underfunded pensions than the poor state of the economy; the use of pension funds as a piggy bank for state governments is a significant cause for the crisis. Due to the nature of pension plans, governments have access to large sums of money and after the needed funds from the pension plans are met for the year, the government has, in their view, usable cash. Instead of letting this cash accumulate, politicians often find different uses for the funds. The shortsightedness of politicians has led to a "kick the can down the road" philosophy; in other words, politicians make myopic decisions that only consider the present conditions of their budget with a mind set on re-election. In theory, as long as the money remaining in the account is invested and is making the estimated returns, there should be no problem.

However, the estimated returns are just that, estimates, and sometimes these estimations could be overly optimistic. The higher estimated returns allow for governments to justify taking more money from the fund since the higher rate of returns used in valuations require less cash to meet future goals. Along the same lines the underfunded pension funds are the result of unsustainable guarantees from politicians. The issue is some deals promised can be accessed relatively young and the benefits are substantial. The President of the Civic Committee of the Commercial Club of Chicago, R. Eden Martin, told NPR that, "in Illinois, if you're a state employee, you can retire at either 60 or 55 depending on which pension plan you're in, with a full pension if you have enough years in the pension system." Furthermore, Martin went on to state that these employees' health care premiums are paid for once they retire; promises like these are exacerbating the pension problem especially in states such as Illinois whose pension funds are severely underfunded already. In another segment of NPR's 2010 series, a former member of the Pennsylvania House of Representatives and an employee for the state teachers union, Steven Nickol said, "Some of the worst things are done in the best of times." Steven was recalling how in the early 2000s when the economy was doing well and the pension funds were in surplus, Pennsylvania and other states decided to increase benefits dealt out from the pension funds. Incidents like this highlight some of the thought process that went into decisions that ultimately increased the deficit in pension funds in the US. According to NPR the Public School Employees' Retirement System of Pennsylvania had a $9.5 billion surplus in 2000, in 2009 the fund was $15.7 billion underfunded.

2.2 An Aging Population:

Shifting age demographics is not solely an issue in the United States; across the globe, fertility rates are expected to decline. Additionally, according to the UN the number of people over 60+ is expected to double by 2050 and triple by 2100. In order to better understand and define the issue the dependency ratio is used. This ratio is defined as the number of people 65 and over divided by the number of people between the ages 15-64. The inverse of this ratio can be interpreted as the number of workers providing for a single dependent 65 and over. Referring to the chart below, the dependency ratios for 1970, 2010 and predictions for 2050 can be observed for several nations.

As can be seen, in the past years these nations have enjoyed relatively high ratios but moving forward the outlook is somewhat bleak. The UN cites the cause behind this issue as a large number of the population entering the 60+ years of age category (in the United States these are the baby boomers), longer life expectancy and lower fertility rates.

Country	1970	2010	2050 (projected)
United States	5.3	4.5	2.6
Japan	8.5	2.6	1.2
Britain	4.3	3.6	2.4
Germany	4.1	3.0	1.6
France	4.2	3.5	1.9
Netherlands	5.3	4.0	2.1

Often a commonly cited concern with social security deals with the baby boomers and their longer life expectancies. This problem could also become a concern for pension funds with a greater amount of employees entering retirement and a smaller pool of potential employees entering the workforce. In order to counteract this shifting demographic trend, there would need to be larger contributions by employers and the government or renegotiation of pensioner's payments to fill the void of the depleting support ratio. If the government is unable to renegotiate current pension fund agreements this could mean more burden on the taxpayers. If none of these options prove to be successful, there would be no alternative but for pension plans to default on payments.

Empirical results from the U.S. Census Bureau paint an even grimmer picture. In 2014, support ratios, members to beneficiaries, from our sample group ranged from 1.70 to 3.70 with an average of 2.35. This indicates that large states have even lower support ratios than the U.S. average. This can be problematic as reform will need to address these states immediately. Additionally, pensioners are more heavily concentrated in large states, meaning they represent a very large portion of the U.S. pension crisis.

2.3 Plan Deficits:

U.S. Census data for our sample indicates that all states aside from Washington, D.C. and New York have higher future pension obligations than total cash and investment holdings. This appears problematic, as they will have trouble making future obligations. The average state was underfunded by $32.4 billion dollars in 2014.

Additionally, 2014 yearly contributions to total annual payments were analyzed. The results supported our assertion above that all pension funds are working on a deficit. All fifteen states in our sample had total payments exceeding annual contributions, which indicated these pension funds paid out more to beneficiaries in 2014 than they received from pension contributors. Data from the U.S. Census Bureau supports that pension funds are grossly underfunded. Current pension obligations far exceed annual contributions. Additionally, state pension plans have support ratios that are diminishing.

The financial crisis in 2008 created significant issues for pension funds. Pension funds characteristically have high exposure to equity markets. As a result of the housing market crash, public pension funds lost significant value in their assets and increased value of their liabilities causing a widening pension gap already exacerbated by shifts in age demographics.

3. Methodology, Data and Empirical Results:

In depth analysis to assess the current pension crisis and its uncertain future involves investigating a number of issues. As stated above, the economy, funding plans, and dependency ratio all play a significant role in the public pension crisis.

This report used the U.S. Census Bureau pension data for the fiscal years2005-2014 to select a sample of 15 states. The U.S. Census Bureau provides public pension data for state and local pensions annually. For the purposes of this report we will utilize data from the state pension plans of Arizona, California, Colorado, District of Columbia, Florida, Georgia, Illinois, Maryland, Massachusetts, New Jersey, New York, Ohio, Pennsylvania, Texas, and Virginia. These states have large populations and correspondingly large pension plans.

This report will start by analyzing the support ratio also known as the dependency ratio; this is defined as the ratio of current employees to pensioners, as that is the most elementary measure of pension plans. Decreasing trends in the support ratio will indicate a shifting demographic tendency of the workforce. That is, the number of individuals over the age of 65 years old receiving retirement payments will be increasing when the number of current workers contributing to the plan will be decreasing, relative to pensioners. If support ratios become too low, there will be an inadequate number of workers paying into the pension fund to provide sufficient support to pensioners.

Further analysis of pension obligations compared to assets will also be conducted. For a pension fund to be positive and operational it is necessary for investment holdings to be greater than future obligations. The total cash holdings, annual contributions and total payments to pension obligations each year for all states will be calculated in the sample. The ratio we used is Obligation/Assets.

Investigation of other economic factors will be discussed. Interest rates have been low for over a decade in an effort to stimulate the economy. This can influence the value of assets and liabilities if they are not sufficiently immunized to protect against such economic shocks such as abrupt changes in market interest rates. Average investment return over the past five years was used in the Z2 formula. Investment income as percentage of pension obligation was also used in the Z2 formula. Additionally, using incorrect discount rates can lead to incorrect predictions in the returns a fund can achieve over a set period of time, as well as the future value of obligations needed to be made to pensioners.

3.2 Empirical Results:

In order to get a more comprehensive look at characteristics of pension plan's ability to pay its obligations, a multiple discriminant analysis (MDA) model is deployed to pursue the potential factors. The first MDA model uses dependency ratio and obligation/assets as independent variables. A value of 1.2 or higher in obligation/assets ratio indicates high probability of pension plan failure. The dependent variable used to represent this situation is a Z1 score that has either the value greater than or less than 0. A Z1 score greater than 0 implies the probability of pension plan failure is greater than 50 percent. If Z1score is negative, the chance of pension plan failure is less than 50 percent.

$$Z1 = -0.2987 - 1.043 \text{ (dependency ratio)} + 1.865 \text{ (obligation/assets)}$$

Table 1below exhibits the number of states yielded a negative or positive Z1 value during 2005-2014. A negative Z1 value implied greater chance to remain solvent in paying pension obligations, vice versa for positive Z1 value.

Table 1: Z1 value during 2005-2014

Year	Z1 value Positive	Z1 Value Negative
2005	2	13
2006	3	12
2007	3	12
2008	5	10
2009	6	9
2010	6	9
2011	6	9
2012	6	9
2013	4	11
2014	4	11

A more complete discriminant function was developed to include more independent variables. The model was fitted as follows:

$$Z_2 = 0.454\ X_1 + 0.325\ X_2 + 0.748\ X_3 + 0.66\ X_4$$

Where:

X1 = dependency ratio

X2 = Asset/Obligation ratio

X3 = Average investment return over past five years

X4 = Investment income as percentage of pension obligation

A greater Z2 value indicates the less probability of failing pension plan. A Z2 value of less than 2.10 indicates high probability that a pension plan will fail; Z2 value of greater than 2.89 indicates low probability of fail; Z2 value from 2.10 to 2.89 is undetermined.

The table 2 below exhibits the number of states yielded a Z2 value greater than 2.89 or less than 2.10. A higher Z2 value implied greater chance to remain solvent in paying pension obligations, vice versa for lower Z2 value.

Table 2: Z2 value during 2005-2014

Year	**Z2 value < 2.10**	**Z2 Value > 2.89**	**Z2 value 2.10-2.89**
2005	2	11	2
2006	2	10	3
2007	3	10	2
2008	4	9	**2**
2009	6	8	1
2010	6	7	2
2011	7	7	1
2012	5	9	1
2013	3	11	1
2014	3	11	1

4. Example of Pension Reform:

In the wake of the Pension Crisis, many politicians, scholars, and analysts have been investigating the problems, and researching methods that they feel would solve the current crisis and allow for a sustainable alternative. What can be done now to fix the current problem and what can be done to create a more sustainable pension fund for the future? In order to create a more sustainable retirement fund, the defined-benefit pension may have to be eliminated in favor of other plans.

With the current issue being centered on enormous pension deficits, many cities are fighting to reduce the deficit while also attempting to stay true to their obligations to workers, unions, and public works. Many cities are facing the fact that without an agreement for pension reform, the next step is either a massive tax hike or gutting essential services that have already been depleted. One city, the city of Lexington, serves as a model of how pension reform can be agreed upon in order to meet short term and long-term obligations. Lexington was able to convince 76% of beneficiaries to vote in a reform plan that was able to cut their unfunded liability by 45% and institute comprehensive benefit changes.

Lexington was able to reach an agreement in part because of a combined consensus that something had to be done, and in part by how the plan centers on "sharing the pain". The pain was shared across all beneficiaries by not excluding any of the "sacred cows", such as cost of living adjustments and contribution rates, from negotiations. On top of that, Lexington nearly doubled its historic cash contribution and committed itself to paying down the remaining liability, through State law. For instance, an example of what exactly was affected by negotiations, was the 1% increase in active firefighter and police officer paychecks that now go towards the pension fund. Additionally, new employees in these branches are staying on the job 5 years longer, putting in 25 years until they can retire with vested benefits. Lower tiered COLA rates have been implemented for retirees (though these rates can rise after the health of the fund is secured, based on a formula that is focused on maintaining at least an 85% funding rate.)

With this plan, Lexington is also attempting to avoid "kicking the can down the road", by creating a full solution. Lexington is hopeful that the half-measures that will be offered will allow for long-term success in reducing their unfunded liabilities, which will in turn reduce annual payments to manageable levels.

Lexington is a good example of when negotiations can work, and how those negotiations can lead to success in reducing the pension deficit while also having a long-term outlook. The approach Lexington took may not work for everyone. This plan specifically committed itself to saving the defined-benefit model of pension funds, whereas many believe that lasting solutions lay with a plan that ditches that pension model. (Gray)

In order to create a sustainable pension fund for the future, steps have to be taken to look into what is fundamentally wrong with current pension funds and attempt to correct the mistakes. Earlier, it was stated that one of the most pertinent issues with current pension funds is the way in which the liabilities of the pension fund are valued. The discount rate currently is equivalent to a return, which it is not; the discount rate is a price. The growths in the present value of the liabilities that make up a pension fund are just as volatile as a long-bond portfolio. This is because the growth depends on interest rates. The current methods of valuing pensions have not only led to egregious mistakes in pricing, but also allow for corporations to manipulate pricing and ROA to eliminate pension expense and inflate earnings. These aspects combined have created a scenario where it is now arduous to successfully promote and instate any policy changes to price liabilities correctly.

According to Frank J. Fabozzi and Ronald J. Ryan in a paper about pension reform, to fix the issues with pension pricing is for the pension to generate a custom benchmark that is based on its liabilities' cash flow

structure and properly discounted using market interest rates. The current rules of pricing liabilities are very beneficial for corporations and switching to the new recommendation would be highly unpopular. Currently, the rules state to compute the liability, the agency uses an equally weighted mix of three corporate bond indexes whose returns are weighed over four years: 40 percent for the current year, 30 percent for the past year, 20 percent for the year before that, and 10 percent for the year before that. The IRS also allows a "corridor" of 90 to 120 percent of the resulting fund to give companies enough wiggle room. How and why using the historical data of the past 4 years the value a pension was ever conceived is a mystery. Additionally, Fabozzi and Ryan state that given how volatile interest rates are, a blended concoction like what is being done can never represent an accurate pricing of liabilities. Too high of a rate would be produced in a bull market, and vice versa in a bear market. Furthermore, the wide corridor that is allowed in the current rules effectively protects pension plans from having to make contributions unless they are found to be grossly underfunded.

Therefore, until the liabilities of pension plans are priced at a market value, pension funds will run the risk of an asset-liability disconnect. A rule of thumb should be: "If you cannot buy it, you cannot use it as a discount rate." A good starting point would be the Treasury zero-coupon yield curve. Once the liabilities are correctly priced and benchmarked, they can be properly managed like assets, which is something that fund managers can easily relate. These liabilities will then be able to be managed, and compare growth and risk behavior with asset allocation and performance measurement models. (Fabozzi)

5. Conclusion:

This paper has discussed how the public pension crisis has come under increasing scrutiny over the past decade due to shifting demographic trends, mismanaged funds and harsh economic conditions. It has shown that the very nature of pension funds has changed, and not for the better. Poor forecasting and planning has wrought havoc on the pension funds. Specifically, poor decisions in determining pension fund discount rates have left pension funds short of their requirements and consequently many organizations in the hole. Although the idea of pension funds is great, being that they create valuable saving and investment tools for an individual's retirement, their execution has been horrendous. In theory, pension funds should work, but organizations will have to take steps towards reforming their bad habits in order to take advantage of pension funds. Pension reform has been introduced in various ways including, switching to other retirement plans such as 401(k)s or IRAs, as well as reforming the typical pension plan. While completely dropping the pension plan may seem like a good idea, many organizations have been looking for ways to salvage the typical pension fund, and some have been successful in that regard. If organizations want to salvage their funds, they will have to be forgoing their expense cutting and current discount rate forecasting habits, and begin using more realistic market driven discount rates to value their liabilities. The pension fund can be saved; it will just take commitment and cooperation amongst government and their pension holders.

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